Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Unlicensed Operation in the Band 3650 – 3700 MHz	)	ET Docket No. 04-151
	)	
	)	
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band	)	ET Docket No. 02-380
	)	
	)	
Amendment of the Commission's Rules With Regard to the 3650 – 3700 MHz Government Transfer Band	)	ET Docket No. 98-237
	)	

COMSEARCH COMMENTS

Comsearch, pursuant to §1.415 of the FCC rules, hereby respectfully submits the following comments in response to the Notice of Proposed Rulemaking (NPRM) in the above captioned proceedings.

Comsearch, headquartered in Ashburn, Virginia specializes in spectrum management of terrestrial microwave, satellite and mobile telecommunications systems. Comsearch interacts with the Commission and the National Telecommunications and Information Administration (NTIA) and actively participates in various industry groups such as the National Spectrum Managers Association (NSMA), the Telecommunications Industry Association (TIA), Institute of Electrical and Electronics Engineers (IEEE), and the Wireless Communications Association International (WCA) to develop rules, industry recommendations, and standards to promote the efficient use of the radio

spectrum. Since 1977, Comsearch has been a leading provider of engineering services and software for mobile, microwave and satellite communications systems, both domestically and internationally. In this role, we have gained extensive experience in developing industry-standard coordination processes, developing and maintaining state-of-the-art software and databases, performing interference analyses of complex environments, and understanding regulatory requirements.

The Commission proposes in the NPRM to allow unlicensed devices to operate in the 3650 – 3700 MHz band and seeks comment on a number of issues related to this proposed allocation. In particular, the NPRM points out potential interference concerns with incumbent systems and presents two general approaches for enabling fixed and non-fixed unlicensed devices to operate while protecting incumbent Fixed Satellite Service (FSS) earth stations and Federal Government operations in the band. The first approach, applicable to fixed devices, relies on professional installers to ensure that certain distance and interference criteria are met. The second approach, applicable to non-fixed devices, requires "smart/cognitive features" including signal detection and automatic power adjustment.

As discussed below, we believe there are significant drawbacks to the approaches the FCC has described for avoiding interference with licensed operations. Considering these limitations, we believe a device registration system would be much easier to implement and would provide both direct and tangential benefits. Our comments will examine the drawbacks inherent in the approaches proposed in the NPRM and outline

why a device registration regime would satisfy the Commission's objectives of maximizing the efficient use of the 3650 – 3400 MHz band while safeguarding incumbent licensed users.

Fixed Unlicensed Operation

To ensure that fixed unlicensed devices are operated in a manner that will avoid causing interference to incumbent systems, the NPRM proposes a requirement for professional installation, sets limits on system EIRP, and establishes an exclusion zone around FSS operations.[1]

Using the Part 101 coordination process, licensees have successfully managed interference between FS and FSS systems for over 30 years. These bands are shared by tens of thousands of fixed point-to-point systems and satellite earth stations. There are well-documented industry accepted algorithms and procedures to quantify the interference potential when the location and operating parameters of every device is known.

The Commission's proposal to implement an exclusion zone around FSS earth stations ignores all of the good engineering practices derived from this past experience. Instead of using "real world" analysis techniques, including terrain modeling and antenna discrimination, the Commission is creating an arbitrary exclusion zone that may be too restrictive or too lax depending upon the actual interference geometry involved. The NPRM proposes the use of FSS Protection Zones, areas within which unlicensed use

[1] NPRM at ¶¶41-47.

would be prohibited[2]. Specifically, the protection zone is defined as a 180 km distance within an arc of plus-or-minus 15-degrees from an earth station's main beam and a distance of 25 km for all other azimuths. The Commission is proposing that professional installers be responsible for identifying this protection area to ensure that no devices are located within these zones and states that it would be a simple matter to reference FSS operational data in IBFS to determine proximity to the exclusion areas.

There are two problems with the FCC's approach. First, since earth stations may coordinate and license a satellite arc range it is not possible to determine a single pointing angle for such an earth station. Instead, the earth station could use a range of look angles that would allow it to use any satellite within the licensed arc. Second, while an earth station may be authorized to use satellites between 25 degrees west longitude and 143 degrees west longitude, only the easternmost arc positions would involve the international service, and perhaps not all of the satellites in those positions would use the 3650 – 3700 MHz segment. The FCC licensing data does not allow the determination of whether the 3650 – 3700 MHz segment is used at a particular satellite or arc position. Therefore, a worst-case range of azimuths must be used to define the protection zone.

Consider an FSS earth station in the international service located in New York, NY that is authorized to use satellites between 25^{o} west longitude and 56^{o} west longitude. The look angles for this range of satellite positions are 119.6 degrees azimuth towards the farthest eastward position (25^{o} west longitude) and 153.7 degrees azimuth towards the farthest westward position (56^{o} west longitude). The earth station could be operating at any satellite within this range of azimuths and therefore the unlicensed operator would be

[2] See NPRM at ¶¶ 45-47.

obligated to add plus-or-minus 15 degrees to this "main antenna beam" position resulting in a protection zone distance of 180 km for the azimuth range 104.6 degrees to 167.7 degrees. For comparison purposes, Figure 1 shows this protection zone along with the actual separation distance required for an earth station located in New York, NY.

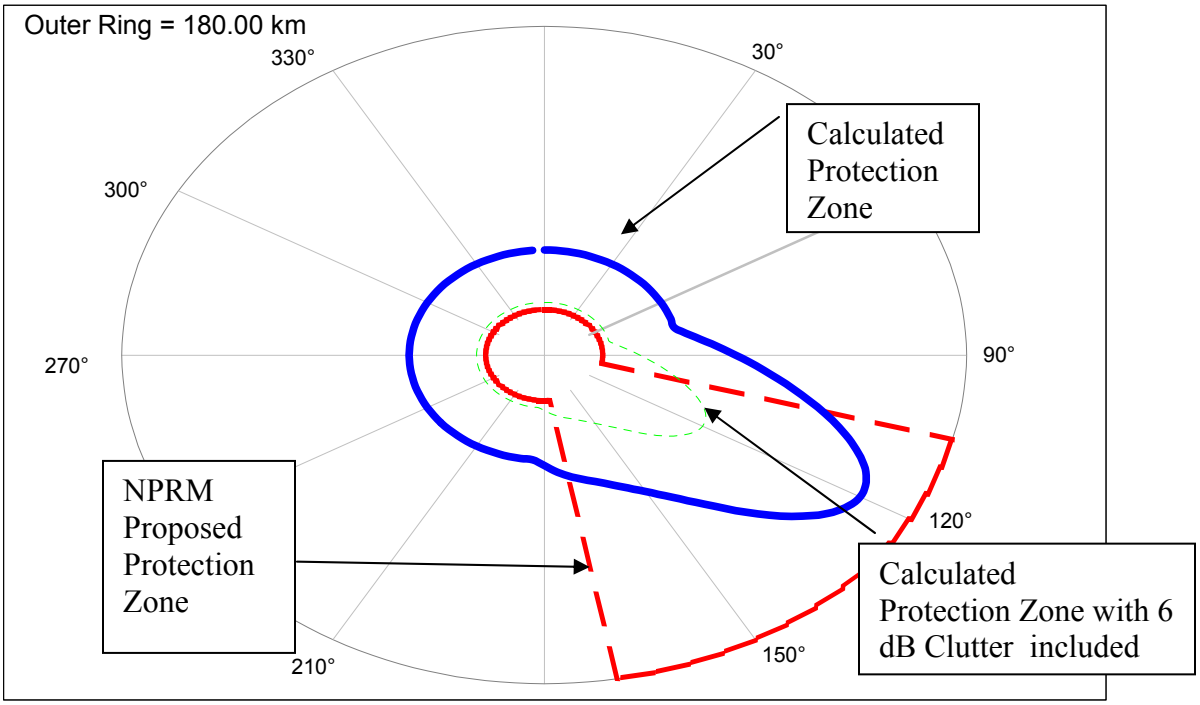

Figure 1 – Comparison of FSS Protection Zones

Example Earth Station

- Site Location: New York, NY
- Latitude: 41° N
- Longitude: 74° W
- Satellite Arc: 25° W.L. to 56° W.L.
- No clutter considered in protection zone calculation (dark line)
- 6 dB clutter considered (light dashed line)

The figure compares the FSS protection zones proposed in the NPRM (lighter dashed line, red) and those calculated based upon LOS and operating parameters noted above (darker solid line, blue). In the direction of the satellites the FCC proposed zone is too conservative and in the area outside of the main beam the 25 km zone is too permissive.

Actual operating parameters, especially when considering earth curvature, terrain, and above terrain blockage would provide a much more spectrally efficient manner to calculate protection zones.

Non-Fixed Unlicensed Operation

The Commission's proposed approach to protect incumbent systems from non-fixed unlicensed operation stipulates the use of lower power limits than for fixed systems and a listen before talk, power adjustment capability. To initiate the listen before talk feature, the Commission proposes to use the FSS uplink transmissions in the 6 GHz band as the trigger whereby the received signal level from the earth station determines the transmit power level of the unlicensed operation. A minimum power-switching detection threshold of -76 dBm referenced to a 1 MHz bandwidth is proposed.

We feel that there are major problems with this concept. Earth stations receiving in the 3650-3700 MHz are not necessarily transmitting in the corresponding transmit portion of the extended C-band. In fact, since this band is for international use the corresponding transmit signal would likely be at an earth station located outside the United States. Also, FSS stations transmitting in the extended C-band may not necessarily be receiving in the 3650-3700 band and thus would not require protection. Furthermore, there are many other systems that transmit in the 6 GHz band segments noted in the NPRM. Broadcast Auxiliary Services (BAS) and Local Television Transmission Services (LTTS) operate in the 6425-6525 MHz segment, point-to-point microwave relay stations are very plentiful in the 6425-6725 MHz segment, and the allocation of the 5850 –5925 MHz segment to Dedicated Short Range Communication

Services (DSRC) may introduce many more transmitters in the band. The unlicensed devices would not be able to distinguish earth station transmissions from transmissions of any of these other systems, and therefore would often reduce power or cease transmitting unnecessarily. Instead of attempting the complicated listen-before-talk scenario outlined in the NPRM, we propose the use of geo-location based technology such as GPS. So equipped, these devices could tie into a database containing up-to-date operating parameters of licensed FSS. The software would then characterize the interference environment based upon the device's location. The information passed back to the device would set appropriate power limits. We propose that the "system smarts" reside in the central server eliminating the need for costly features to be included in every non-fixed device.

Proposed Approach

We believe that the best approach to facilitate the introduction of new and advanced services, either unlicensed or licensed, in the 3650 – 3700 MHz band is through the implementation of a device registration regime. Controlled by a central administrator, the database and associated software would provide fixed users with interactive web-enabled data entry, interference analysis, conflict-notification, and site location approval. For non-fixed devices, the registration system would be capable of networking with location-based technology to continually characterize the interference environment on behalf of the device. If properly implemented and administered, a device registration regime provides significant advantages over the implementation approaches put forth in the NPRM. Registration can do the following:

1. Provide practical ongoing interference protection of licensed FSS.

Quantifying the interference potential between fixed unlicensed devices and licensed FSS can be accomplished quickly and easily through device registration by using existing industry recognized prediction techniques. This automated interference analysis can quickly assimilate actual operational data to determine if a proposed fixed location will cause interference to an existing FSS station. There is no need to rely on assumptions about each system's operations that may result in worst-case or erroneous exclusion zones. If the interference parameters, geometry and geography allow, fixed systems can operate much closer than the 180 km boresight limitation specified in the NPRM and conversely, given the right interference geometry, it can be shown that interference will be detected from devices further away than the 25 km exclusion area when outside of the earth station antenna boresight. The use of industry accepted prediction algorithms will provide an accurate depiction of the interference environment and afford licensed FSS with the greatest level of protection from fixed unlicensed devices while at the same time maximizing access to the band. The automation and power of today's software relegates the use of static exclusion zones to the past.

2. Allow for expansion of FSS facilities

The same methodology outlined in item 1 above could be used to determine the impact of expanding FSS on registered fixed unlicensed devices. As stated in the NPRM, it is anticipated that any expansion of FSS in the band will be limited to a small number of locations and therefore should be manageable from an interference standpoint. Regulatory issues regarding the limits, if any, on the amount of FSS expansion to be

allowed and the treatment of deployed fixed unlicensed devices that might be affected by future FSS expansion need to be clarified. We believe that some level of FSS expansion is possible under a formal registration process because it provides a useful framework that promotes band sharing.

3. Allow calculation of distance from protected Government facilities and provide interaction with the NTIA.

To protect the three designated Government Radiolocation facilities outlined in the NPRM, the registration process would immediately identify and flag fixed devices proposed within the 80 km protection radius. Automated data interaction with the NTIA would be established for notification and approval purposes. A similar type of process is currently under design for the recently allocated 70 – 90 GHz band.[3] NTIA could also utilize the registration data to ascertain whether any pre-planned deployment of mobile radars in the adjacent 3600 – 3650 MHz band might pose a proximity problem to a registered device. Although there is no obligation to avoid interfering into an unlicensed device, it would provide the NTIA and other Government agencies the ability to consider alternate locations or to notify the device operator prior to operation.

4. Protect Operations in Proximity to U.S. Borders

The registration software would perform the necessary checks to determine if the distance protection criteria are met along the Mexican and Canadian borders. In the NPRM, the Commission proposes to require fixed devices be located at least 8 km from

[3] This process is anticipated to include an interactive web interface that will automatically return a "green light" (all clear) or a "yellow light' (requires further study) response.

the U.S./Canada or U.S./Mexico border if the antenna of the device looks within the 160 degree sector away from the border and be located at least 56 km from each border if the device looks within the 200 degree sector towards the border. In addition to checking for distance compliance, another advantage provided by device registration is that known licensed facilities in Mexico and Canada can be considered in the initial interference analysis just as they are currently for Part 101 systems.[4]

5. Provide interference notification to licensed FSS earth stations operating in the adjacent 3700 – 4200 MHz band.

The NPRM proposes to protect licensed receive earth stations in this adjacent band using current Part 15 rules, specifically a maximum field strength of 500 microvolts per meter at a distance of 3 meters. Since these are the current rules this seems reasonable; however, there are many earth stations licensed in the 3700-4200 MHz (4 GHz) band and many of these facilities employ inexpensive low noise amplifiers which can be overloaded when interference even from out-of-band emitters is present. Since many of these unfiltered LNBs and LNAs have passbands which extend beyond 3650 MHz all of the energy from unlicensed devices in this band could potentially drive the amplifier into saturation and disrupt service. The table below shows that if only one unlicensed transmitter is within 0.35 km of an adjacent band FSS earth station, even if the angle of approach is outside of the main beam (54.5 dB down from main beam), that the LNB could be driven into saturation. Multiple unlicensed transmitters at potentially more damaging pointing angles could cause problems for adjacent band FSS receivers.

[4] Engineering data for most licensed systems in Canada is available from Industry Canada. Information on systems operating in Mexico is generally unavailable and therefore more problematic.

Table 1 – Effect of Unlicensed 3650-3700 Transmitter on Adjacent Band, 3700-4200, Earth Station

EIRP of Interferer	14	dBW				
	44	dBm				
Separation Distance (km)	0.35	km				
Free Space Loss	94.7	dB				
ES Gain Discrimination	54.5	dB				
Interference Level at FSS Station	-105	dBm				
Example of Receive Link				Single Transponder Level (dBm)	Full Satellite (12 Trans) (dBm)	Full Satellite + Unlicensed Interferer (dBm)
Satellite Link OPBO(dB)	3	dB				
EIRP at Receive Earth Station	32	dBW	Antenna In	-167	-156.2	-105.2
Antenna Receive Gain	44.5	dBi	Antenna Out	-122.5	-111.7	-60.7
Antenna to LNA Loss	1	dB	LNB Input	-121.5	-110.7	-59.7
LNB Gain	50	dB	LNB Output	-71.5	-60.7	-9.7
						LNB in saturation
For this example, the LNB may have a max rated output of -10 dBm, so under normal conditions for full satellite use and considering other noisy inputs (cross-polarized signals, adjacent satellite signals, other spurious inputs, etc) proper operation will be assured. Note that for full satellite operation the LNB output is well below the rated spec. However, if an interfering signal occurs within the passband of the LNB, the LNB will be over-driven and the output will be above spec. This will result in signal suppression of the wanted carriers (clipping), an increase in the noise floor (reduction in carrier C/N), and phase non-linearities.						

Device registration, along with a database of licensed 4 GHz earth stations, would identify fixed unlicensed devices posing a potential interference risk. The parties could be notified electronically and coordinate with each other to resolve any problems. The device registration database would also provide licensed 4 GHz earth station operators with the ability to review fixed unlicensed device deployments prior to engineering new sites.

6. Facilitate deployment of fixed unlicensed devices in the band

One of the significant benefits of device registration is that it would provide a formal means of coordination among unlicensed device users to minimize interference conflicts such as those occurring in the unlicensed 2.4 GHz band. Upon registering a device to determine the interference potential into FSS and satisfying the various Government protection criteria mentioned above, an interference analysis could be performed to identify any potential conflicts with other existing fixed unlicensed devices. The outcome of this check would simply be an email notification to both parties if a potential problem was identified. This notification would not require any formal action but would help to stimulate coordination and interference harmonization among the parties resulting in a more efficient use of the spectrum.[5]

7. Enable less costly, more efficient implementation of unlicensed services

Device registration offers the simplest, least costly and most efficient approach to managing the spectrum in the 3650 – 3700 MHz band. With device registration there would be no requirement for professional installers eliminating the costs of developing and implementing a formal certification program and the costs to hire a professional installer for each device.

The elements of device registration are available today and do not require years of technology development. Device registration databases and software can be used in

[5] This process is similar to the concept behind the regional Broadband Access Network Coordination (BANC) groups whose efforts in spectrum management were recently commended by Chairman Powell. BANC members represent operators who work together to minimize interference and maximize reliability and spectrum efficiency, primarily in the unlicensed bands.

conjunction with geo-location technology to eliminate the need for expensive and unworkable "listen-before-talk" capability for non-fixed unlicensed devices.

Licensed Use of the Band

In addition to proposing an unlicensed allocation for the band, the Commission seeks comments on other possible approaches to maximize efficient use of the 3650 – 3700 MHz band including whether spectrum should be designated for licensed use.

If any portion of the spectrum is designated as licensed we favor the use of traditional Part 101 site-by-site licensing. As stated in the NPRM, this licensing scheme allows access to the spectrum and market entry at a relatively low upfront cost. Through the established frequency coordination process, it affords users with a relative guarantee of interference free operation on an ongoing basis. Proper frequency planning techniques also work to optimize spectrum usage by promoting compatible deployments and frequency reuse where possible.

Respectfully Submitted,

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